

MONTHLY WEATHER REVIEW,

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WAR DEPARTMENT,

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DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In compiling the present Review, use has been made of all meteorological data received up to January 15th from the Voluntary Observers, Army Post and Signal Service Stations. The most prominent features in the meteorology of the month have been: 1st. The large number and very rapid movement of the areas of low pressure. 2nd. The low temperature which has averaged from 2° to 8° below the average for many years throughout the country east of the 100th meridian, as was anticipated in the Review for September: on the Pacific slope the month has been warmer than usual. 3rd. The absence of any area of very high pressure west of the Mississippi. 4th. The remarkable meteor of the 21st. 5th. The interesting solar halo of December 23rd. 6th. The absence of rain on the Pacific coast.

BAROMETRIC PRESSURE.

In General.—The distribution of average pressures for the month is shown by the isobars on Map No. II. The highest average is there located in the Lower Mississippi valley, with a nearly equal pressure in eastern Dakota. The lowest pressure is, as usual, over the Gulf of St. Lawrence. The isobar of 30.00 passes from Lake Superior southeastward to New Jersey. The average pressures at stations received since the map was printed are Virginia City, 29.75; Fort Sully, 30.17; Pembina, 30.16; Bismarck, 30.06.

Areas of High Barometer.—No. I.—On the morning of the 1st of December the pressure was 30.85 in Dakota, diminishing thence eastward to the Atlantic. On the morning of the 2nd the pressure had very generally diminished west of the Mississippi but increased to the eastward. The area of highest barometer extended from Minnesota southeastward to Louisiana, with temperatures of -5° and $+25^{\circ}$ in these two states respectively. On the morning of the 3rd the highest pressure continued to extend from Manitoba to the Gulf States, but gradients had generally diminished. On the morning of the 4th the pressure was highest in the Lower Missouri valley, and on the morning of the 5th in Louisiana and Mississippi, while low barometer No. I was central over Manitoba. The area of highest pressure now moved eastward and was, on the morning of the 6th, central in Alabama, and on the morning of the 7th in Georgia and Florida.

No. II.—This area appears on the morning of the 8th central in Texas, where it had apparently been formed by the flow of air from the northwestern portion of the State, in connection with the low barometer No. II that was then developing in the Lake region, and the falling pressure in the South Atlantic States. During the rest of December 8th the very general flow of cold air from the Northwest caused an extension of the area of high pressure over the whole country west of the Mississippi. The very severe storms known in local parlance as "Blizzards" were reported on the 8th as prevailing in Iowa and Wisconsin, where temperatures of -15° and -20° prevailed, with violent NW. winds and much drifting snow. On the morning of December 9th the highest pressure was central over Missouri, Illinois and Tennessee, whence it moved rapidly to the southeastward, being central over North Carolina on the morning of the 10th.

No. III.—The low pressure that prevailed on the 11th over the Lake region was, as usual, attended by rising barometer, extending from the Gulf northward over the Gulf States, where it was quite well-marked on the morning of the 12th. The central highest pressure was, however, by the morning of the 13th, transferred eastward to the South Atlantic coast.

No. IV.—The low pressure No. VII, over Lake Superior on the morning of the 14th, had, during its southeastward progress through British America, been followed by rising barometer on the Pacific coast. During the 13th, and on the morning of the 14th the pressure was highest in Dakota, with very steep gradients eastward over Minnesota and Lake Superior. This formed a small but well-defined area of high pressure, which moved rapidly southeastward, being on the morning of the 15th central in Arkansas, and at midnight of the 15th central in Louisiana.

No. V.—The rapidly rising barometer and very cold, high northerly winds in the rear of low barometer No. VIII, extended rapidly southward over the Northwest, where pressure was highest on the morning of the 16th, whence it extended eastward with unusual rapidity, and was on the morning of the 17th central in New York. This area of high pressure seems then to have taken a somewhat unusual course towards the northeast, being central over the Gulf of St. Lawrence on the morning of the 18th.

No. VI.—The low barometer No. IX was, during the 17th, followed by high pressure No. VI, which moved directly southward and was central on the morning of the 18th in Kansas, and on the morning of the 19th extended from Texas to Georgia, whence it spread over the Southern States, and was merged into the succeeding area.

No. VII.—was central on the morning of the 19th in Manitoba, whence it moved eastward, and was on the 20th, 7:35 a. m., central in Canada, and on the 21st, 7:35 a. m., central in Maine, after which it disappears.

No. VIII.—The slight depression No. XII, which was, on the morning of the 22nd, central in the Ohio valley, was followed by an extended southward flow of cold air over the Western plains, and the highest pressure was, at 7:35 a. m. of the 23rd, central in Dakota, whence it moved eastward over the Lakes, while low barometer No. XIII, developed in Texas and moved eastward along the Gulf coast. The highest pressure was, on the morning of the 25th, central in upper Canada, and on the 26th, 7:35 a. m., central in Maine.

No. IX.—The pressure remained pretty uniform on the 26th and 27th, but was, on the morning of the 28th, highest over the Upper Mississippi valley, Lake region and Middle States, while the severe storm-centre, No. XIV, was on the Louisiana coast. This storm was followed by an extensive area of high barometer, central in the Southwest, on the 29th and 30th, whence it moved northeastward, and was central in Tennessee on the morning of 31st, while storm No. XV, was advancing eastward over the Texas coast.

Areas of Low Barometer.—The areas of low barometer have been numerous, and have moved with unusual rapidity. The highest rate of progress has been that of No. X, being 59 miles hourly. The lowest, No. XIII, being 17 miles hourly. The average of all was 38 miles per hour. Of the fifteen tracks given on chart No. I, seven belong to the Lake region, four passed through Missouri or Illinois, three came from Texas and one belonged to the Atlantic ocean. In general this month has been considered very stormy and unpleasant, both on sea and land.

No. I.—This depression was in Manitoba on the morning of the 5th, having evidently moved southeastward along the slope of the Rocky Mountains, while the barometer had been rising at Portland, Oregon. On the afternoon of December 6th, 4:35 p. m., the depression was very extensive and central north of Lake Huron. December 7th, 4:35 p. m., the depression was apparently central in New Brunswick, and followed by light snow over the Lower Lakes and New England.

No. II.—This depression first appears December 8th, 7:35 a. m., over Lake Superior, whither it had moved from the north or northwest. The barometer fell rapidly during the day over the eastern portion of the Lakes, but was rising rapidly over the western portion, with very low temperatures and northwest gales. By 7:35 a. m. of the 9th the area of lowest pressure, 29.10, extended as an elongated oval from Montreal to Boston, with very cold westerly gales over the Middle States and Lakes. Among the highest winds reported were: Cape May, SW., 72 miles; Grand Haven, W., 49; Erie, W., 48; Port Huron, W., 35; New York, W., 60; Sandy Hook, W., 84; New Haven, W., 40; Newport, SW., 60; Wood's Hole, NW., 50; Wilmington, NW., 29; Rochester, SW., 36; Oswego, NW., 36; Portland, Me., E. 38; Philadelphia, NW., 42; Marquette, NW., 54; Eastport, E., 43; Grand Haven, W., 49; Cape Lookout, W., 50; Barnegat, W., 45; Boston, W., 50. The depression continued moving eastward, and was, December 9th, 11 p. m., central over the Bay of Fundy, with the lowest pressure, 28.80.

No. III.—While No. II, was moving over New England depression No. III, was moving southeastward over Dakota, having evidently originated on the eastern slope of the Rocky Mountains, since the pressure at Portland, Oregon, had remained nearly stationary for several days. December 10th, 7:35 a. m., it was central in the Northwest, whence it moved southeast and eastward, and disappeared over Ohio during the day, being merged into the more extensive depression that followed.

No. IV.—This depression seems also, like No. III, to have rapidly advanced from the Northwest into Manitoba, where it rapidly developed on December 10th, between 4 p. m. and 11 p. m., and on the morning of the 11th was central north of Minnesota; during the rest of that day it extended southward over the

Lake region and Canada, where it was central on the morning of the 12th. During the rest of the day No. IV slowly disappeared during the advance of No. VI.

No. V.—This depression seems to have originated near Cape Hatteras during the 11th between the areas of N. E. winds that prevailed to the northward, and of S. W. winds that prevailed to the southward of this region. It was, on the morning of the 12th, apparently but a slight depression, but a severer storm may have prevailed to the eastward, whose nucleus was central near Halifax at 4:35 p. m., and near Cape Breton at 11 p. m., at which place the pressure had fallen to 29.02, showing that a severe storm was then under way.

No. VI.—This depression first appears in Montana and western Dakota on the morning of the 12th, whence it moved due eastward over the Upper Lakes into Canada, and thence northeast down the St. Lawrence valley, but is not traceable on the weather maps after 4:35 p. m. of the 13th.

No. VII.—This depression very closely followed No. VI, and may possibly be considered as its western portion. It was, 4:35 p. m. December 13th, central north of Minnesota, whence it moved southeastward to Lake Superior, followed by a very steep gradient. On the 14th it moved eastward along the northern limit of Canada, while brisk northwest winds, cloud and snow, prevailed over the Lakes; it was, on the morning of the 15th, central at the mouth of the St. Lawrence.

No. VIII.—Like four of the preceding areas, No. VIII descended from Manitoba southeastward to Lake Superior, where it was central on the morning of the 15th. It continued, during the day, moving southeastward to Lake Ontario, but at midnight turned northeastward, and at 7:35 a. m. of the 16th was central in northern Maine. Gales and high winds from southwest to northwest prevailed over the Lakes, St. Lawrence valley, Middle and Eastern States, on the 15th and 16th, while the central depression seems to have spread over the entire Gulf of St. Lawrence, where the storm was quite severe.

No. IX.—This depression originated in Kansas and northern Texas, over which region warm, southerly winds prevailed on the 16th; these winds, at 11 p. m. of the 16th, extended continuously northward to Montana and Manitoba, and were evidently due to the low barometer that prevailed at the Rocky Mountain and Pacific coast stations. Toward the same region of low barometer there also set in, after 11 p. m. of the 16th, strong north and east winds, which, on the morning of the 17th, prevailed from Kansas and Missouri northward, and were possibly in part a consequence of the precipitation in the form of light cloud and light rain or snow which had taken place before 7:35 a. m., December 17th, over the entire country west of the Mississippi; the depression moved rapidly eastward over the Ohio valley, and thence northeast along the western slope of the Alleghanies to New York, where it was central December 18th, 7:35 a. m., and whence it turned, during the day, abruptly eastward to Cape Cod. It was, at 11 p. m., central near Eastport, Me., the lowest barometer being 29.25, and with severe easterly gales at Halifax and Eastport. Its last location was in the morning, December 19th, near Prince Edward's Island, Gulf of St. Lawrence, with a central pressure of 29.00 or less, and severe storm throughout the neighboring region.

No. X.—This depression seems to have originated on the 18th between 7:35 a. m. and 4:35 p. m. The area of high barometer No. VI, which was then central in Kansas and Arkansas, appears to have supplied an abundant flow of air northward towards Nebraska, Iowa and central Minnesota. The temperatures in these States rose with unusual rapidity between the morning and afternoon observations, some of the changes in the nine hours being as follows: Cheyenne, 27°; Denver, 25°; North Platte, 48°; Fort Sully, 39°; Omaha, 33°; Leavenworth, 23°; Keokuk, 23°; La Crosse, 18°; St. Paul, 22°; Duluth, 18°. Equally decided was the southward flow of cold air from British America toward the same region, on the north side of which temperatures fell or remained stationary. It was in the region between these opposing winds and strongly contrasted temperatures that cloud and haze formed during the day and that the area of lowest pressure was rapidly developed as a trough stretching from southern Minnesota northeastward into British America. On the morning of the 19th this area was central in Canada, with branches extending far to the southeast and southwest, but its farther progress cannot be traced, as it seems to have become merged into No. IX, and the general depression then existing to the eastward.

No. XI.—On the 20th, 7:35 a. m., the low barometer that had apparently been developing in New Mexico during the previous night was central in Indian Territory, whence it moved northeastward, with light rains, in the Gulf States, and was dissipated during the day over the Ohio valley without having been accompanied by high winds at any of our stations.

No. XII.—This depression appears first in western Dakota at 11 p. m., of the 20th, while the temperatures had greatly fallen in Manitoba, with light northerly winds and clear weather. The central depression moved quite rapidly southeastward to Missouri, where it was central 11 p. m., 21st, preceded by extensive rains over the Southern States, thence its course was eastward to the New Jersey coast, which it reached on the 22nd, 11 p. m., accompanied by snow over the Lower Lakes, Middle and Eastern States, and

by high northeast to northwest winds on the Atlantic coast. It was last seen at 4:35 p. m., of the 23rd, east of Cape Breton, moving rapidly northeast.

No. XIII.—The moderate norther that followed low barometer No. XII seems to have been in great part induced by the low pressure prevailing from Texas to California on the 22nd, and to have given rise to the area of rain and subsequent low pressure, No. XIII, which was central on the western border of Texas at 4:35 p. m. of the 23rd. The barometric depression of the 22nd was evidently one of many similar cases in which an area of low barometer, existing upon the Pacific coast of Mexico, is transferred to the eastern slope of the Cordilleras precisely as occurs frequently along the coast from Alaska to Oregon. In both regions the consequences are similar—namely, a strong flow of air westward up the slope of the Rocky Mountains and the formation of areas of cloud, rain and snow with new centres of low pressure. The course pursued by No. XIII was slowly eastward along the Gulf coast to northern Florida, over which it disappeared 4:35 p. m. of the 25th, having been accompanied by heavy rains throughout the Gulf and South Atlantic States, and followed by a severe norther over the Western Gulf coast.

No. XIV.—This area seems to have originated in western Texas under conditions very similar to those attending the formation of No. XIII. It was central near the Texas coast at 11 p. m. of 22nd, whence it moved slowly eastward to the mouth of the Miss., and then turned to the northeastward through Ala. and W. Virg. into eastern New York, where it was central at 11 p. m. of the 29th. The central low barometer had steadily and rapidly fallen from 29.80, at 11 p. m. of the 27th, and 29.65, at 11 p. m. of the 28th, to 28.85, at 11 p. m. of the 29th. At which time, also, the area of snow and rain, with high winds or gales, covered the Lower Lakes, Middle and Eastern States, making this one of the severe storms of a very stormy month. The depression continued its course northeastward on the 30th, and was, at midnight, central over the Gulf of St. Lawrence.

No. XV.—While No. XIV was, during the evening of December 30th, passing over New Brunswick, and the highest pressure was central in the Eastern Gulf States, a third depression, No. XV, was developing in western Texas or northern Mexico, in consequence of the precipitation of moisture that had been carried by easterly winds up the slope of the Rocky Mountains. This depression was central at midnight of the 30th west of Indianola, but at 7:35 a. m. of the 31st was as a violent storm, central between Indianola and Galveston. It moved eastward during the rest of the 31st, with increasing severity, and was on the morning of January 1st, 1877, central in Georgia, while northerly gales prevailed in the Western Gulf. The track of this memorable storm, during the 1st and 2nd of January, is shown on chart No. I, but its further history belongs to the REVIEW for that month.

Storms at Sea have been reported by numerous vessels, among them as follows: on the 1st heavy NW. gales off Cape Horn, also in lat. 44° N., long. 40° W.; hurricane in 37° N., 16° W.; on the 1st and 2nd, NW. gale off Cape Hatteras; on the 4th, heavy NW. gale, 30° N., 70° W., hurricane near the Orkney Islands; on the 7th, storm near Cape May; on the 8th, heavy W. gale off Cape Hatteras; on the 9th, furious NW. gale prevailed along the Middle and East Atlantic coast, increasing to a hurricane force in some localities; this gale was felt at sea as follows: on the Western Bank, also at 40° 15' N., 67° W., at 43° N., 64° W., (a hurricane, bar. 28.80, at 42° N., 61° W., at 40° N., 70° W.; on the 10th the gale of the preceding day continued with high sea, being reported from 41° 44' N., 59° W., 41° N., 56° W., 36° N., 70° W., and 40° N., 70° W.; on the 12th, a terrific gale in the Prince Edwards Islands; 13th, gale with high sea, 41° N., 62° W.; 14th, gale with high sea, 49° N., 37° W.; 15th, heavy gale and very high sea, 48° N., 37° W., also 41° N., 72° W.; 16th, heavy N. E. gale veering to NW. on the Middle and East Atlantic coast; at St. John, N. B., the storm of the 16th and 17th was the severest of the season; wind gusts of 50 miles and heavy snow with great fall in temperature were reported; 18th, heavy gale and high sea, 46° N., 48° W.; 19th, heavy gale, 45° N., 53° W.; hurricane 34° N., 74° W., also a gale 34° N., 43° W., also heavy NW. gale off the Middle Atlantic coast; 24th, heavy NW. gale, 34° N., 74° W.; 26th, heavy NW. gale, 48° 17' N., 34° 50' W., also at 47° 31' N., 37° 30' W.; 29th, NE. gale veering to SW., 26° N., 71° W., also a heavy NE. gale veering to SW., and at times blowing with hurricane force 20 miles SE. of Abesecom, a cyclone was encountered between New York and Bermuda by the Bark Elila Brass; 30th, heavy SW. gale off Cape Fear river bar; 31st, heavy NE. gale and snow storm off the New Jersey coast.

TEMPERATURE OF THE AIR.

In General.—The general distribution of the temperature for the month is shown by the isotherms on Chart No. II. From which it appears that the temperatures have on the Pacific coast, been somewhat above the average. At the stations in the Rocky Mountains the deviations were: Salt Lake City, 3°; Cheyenne, 3°.9; Denver, 1°.7; Santa Fe, 2° 0; all below the average. East of the Rocky Mountains, and for altitudes less than 5,000 feet, the temperatures every where have been much below the average.

The Maximum Temperatures above 70° have been as follows: Corsicana, 72; Denison, 72; Galveston, 70; Indianola, 75; Jacksonville, 71; Key West, 87; Montgomery, 70; New Orleans, 72; San Diego, 77; Shreveport, 70; Berne, Texas, 71; and the maxima lower than 40° have been at Alpena, 38; Duluth, 39; Escanaba, 36; Marquette, 37; Pembina, 35; Pike's Peak, 27; Port Huron, 40. The maximum tem-